Investigation of scaling laws for underwater locomotion and propulsion efficiency

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Current research trends in bio-inspired robots have focused on precise modelling and replication of fish locomotion. This type of propulsion has been shown to be up to 1.5 times more efficient than traditional propellers in underwater applications. The idea has been that outfitting an autonomous underwater vehicle with a flapping propulsors will make it more efficient than current propeller vehicles. This research explores the idea that focusing only on propulsion efficiency does not tell the whole story of an efficient underwater vehicle. Using what is called the *Cost of Transport*, a total system metric of efficiency, various locomotion gaits are studied in terms of energy expended. Whole system scaling laws for flapping and propeller vehicles are formulated in order to better understand the direct comparison between different propulsion mechanisms. This is accomplished with a combination of computational fluid dynamic simulations and experimental robotic and biological data. Our work aims to give insight into where bio-inspired components and traditional components can be utilized to create an overall more efficient underwater vehicle.